

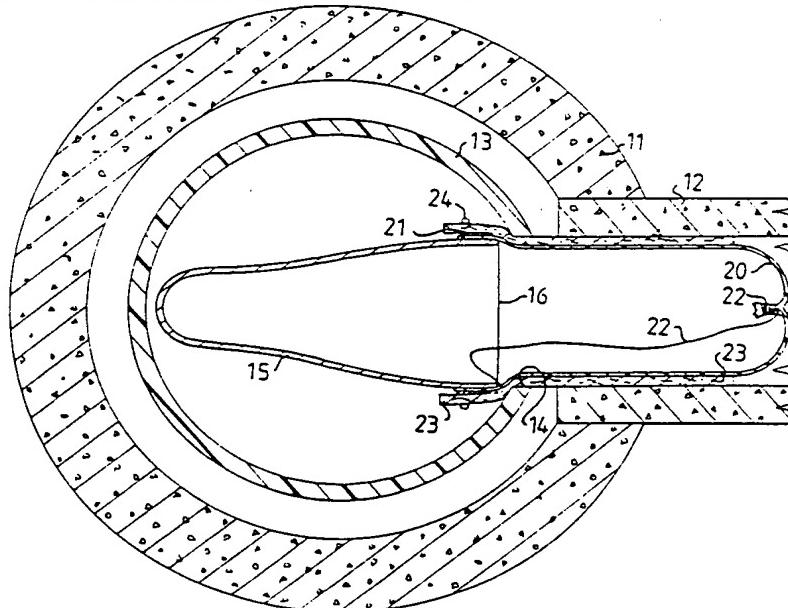


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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## (54) Title: METHOD AND DEVICE FOR RENOVATING A DUCT SYSTEM



## (57) Abstract

Method and device for renovating a duct system, such as a sewer system, comprising a main pipe (11) and a branch pipe (12) by inserting a replacement pipe (13) into the main pipe, then cutting a hole in the replacement pipe opposite the branch pipe and introducing from the interior of the replacement pipe a liner sleeve (23) to bridge the gap between the replacement pipe and the branch pipe. The liner sleeve (23) is formed of fibrous material impregnated with a curable synthetic resin. One end of it is secured around the mouth (16) of a cup-shaped applicator vessel (15) and the main portion is stuck into the vessel, whereupon the vessel is positioned opposite the hole (14) in the replacement pipe (13). Fluid pressure is applied to the liner sleeve (23) by means of an inflatable bag (20) in the vessel (15) to evert the liner sleeve from the vessel into the branch pipe (12) and press it against the wall of the hole (14) in the replacement pipe (13) and the inside of the branch pipe (12). After the synthetic resin has cured, the pressure is relieved and the applicator vessel (15) is removed.

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Method and device for renovating a duct system

This invention relates to renovation of a duct system, such as a sewer system, comprising a main duct and a branch duct connected with the main duct. More particularly, the invention relates to a method of 5 renovating such a duct system which comprises the steps of inserting a replacement pipe into the main duct, cutting a hole in the replacement pipe opposite the branch duct, and introducing from the interior of the replacement pipe a tubular liner which extends from the inside of the replacement pipe and along the inside of the branch duct over at least 10 part of the full length thereof to provide a seal between the branch duct and the replacement pipe. Moreover, the invention relates to a device for carrying out the method. Although it is not limited to any particular kind of duct system, the invention is particularly useful in connection 15 with underground duct systems or other duct systems which are not readily accessible for interior renovation.

In accordance with a known method of renovating such duct systems the liner is formed of a rubber collar having a flange at one end. A pulling rope is inserted into the branch duct from an access point and fed along the branch duct until it enters the main duct and the hole in 20 the replacement pipe where it is picked up and pulled on to a manhole. At the manhole, the smooth end of the rubber collar is attached to the pulling rope. By means of the pulling rope, the collar is pulled along the replacement pipe up to and through the hole until the flange engages the inside of the replacement pipe around the hole. Finally, the pulling 25 rope is caused to release the collar and pulled out of the branch duct.

The need for a conveniently located access point along the branch duct is a disadvantage of the known method.

An object of the present invention is to provide a method which can be practiced with access to the branch duct being had only from inside 30 the replacement pipe. A further object is to provide a device for use in carrying out the method.

According to the invention, there is provided a method of renovating a duct system, such as a sewer system, comprising a main duct and a branch duct connected with the main duct, the method comprising the steps 35 of inserting a replacement pipe into the main duct, cutting a hole in the replacement pipe opposite the branch duct, and introducing from the interior of the replacement pipe a tubular lining element which extends from the inside of the replacement pipe and along the inside of the branch duct over at least part of the full length thereof to provide a

seal between the branch duct and the replacement pipe, characterised by the steps of inserting into an applicator vessel a liner sleeve of fibrous flexible sheet material impregnated with curable synthetic resin and securing one end of the liner sleeve to the vessel around its mouth,

5 positioning the mouth of the vessel opposite the hole in the replacement pipe, evertting the liner sleeve from the vessel into the branch duct and pressing the liner sleeve into firm contact with the wall of the hole in the replacement pipe and with the inside of the branch duct, said evertting and pressing of the liner sleeve being effected by applying

10 fluid pressure to the liner sleeve on the side thereof which is the inner side when the liner sleeve is everted into the branch duct, allowing the synthetic resin to cure and thereupon relieving the fluid pressure.

In accordance with the invention, there is also provided a device for use in carrying out the method comprising a cup-shaped applicator vessel adapted for insertion into the replacement pipe, an inflatable bag which is sealingly attached to the applicator vessel around the mouth of the vessel and which is adapted to be received within the vessel, and conduit means for supplying pressurised fluid into the vessel between the inside of the vessel and the inflatable bag.

20 The invention will be described in greater detail, by way of example, with reference to the accompanying drawings, in which:

Figs. 1 and 2 are diagrammatic cross-sectional views of an underground sewer pipe system being renovated, Fig. 1 showing an initial step in the application of a liner sleeve for bridging a replacement pipe in a main sewer pipe and a branch sewer pipe, and Fig. 2 showing a subsequent step;

Fig. 3 is a longitudinal cross-section on line III-III of Fig. 1.

The diagrammatically illustrated sewer system comprises a main sewer pipe 11 and a branch sewer pipe 12 connected with the main sewer pipe. In the course of the renovation of the sewer system a replacement pipe 13 is inserted into the main sewer pipe 11. The replacement pipe may be made of polyethylene or any other suitable material and consists of shorter or longer pipe sections joined in any suitable manner. No detailed description of the insertion of the replacement pipe is necessary, because such insertion is well known in the art.

35 As a subsequent step in the renovation, communication between the replacement pipe 13 and the branch sewer pipe 12 is established by cutting a hole 14 in the replacement pipe opposite the branch pipe. Such cutting may be carried out using conventional techniques and equipment.

The diameter of the hole 14 is approximately equal to the internal diameter of the branch sewer pipe 12.

To provide a seal between the replacement pipe 13 and the branch pipe 11 a liner sleeve is applied which extends from the interior of the  
5 replacement pipe and along the inside of the branch pipe over at least part of the length of the latter. The application of the liner sleeve and the device used for the application will now be described in greater detail.

10 The device comprises a cup-shaped applicator vessel 15 the height of which is slightly shorter than the diameter of the replacement pipe 13 and the circular mouth 16 of which has a diameter approximately equal to, or slightly greater than, the diameter of the hole 14.

15 Secured to the wall of the applicator vessel 15 is a shank 17 by which the vessel can be attached to a manipulator 18, a so-called robot, so that the vessel can be moved along the replacement pipe and positioned as illustrated with the mouth 16 opposite the hole 14. Moreover, the applicator vessel 15 has a connector for a compressed air hose 19, through which compressed air can be fed into the applicator vessel. The movements of the robot, the positioning of the applicator vessel and the 20 admission and venting of the compressed air are remotely controlled, e.g. from a manhole.

An inflatable bag 20 is sealingly attached to the applicator vessel 15 around the mouth 16. The inflatable bag 20 may be formed of a short length of rubber or plastic tubing one end portion of which is pulled  
25 over the outer side of the mouth portion of the vessel and clamped tightly around at by means of a clamping ring 21. The other end portion of the tubing is tied together by means of a string 22 so that air is prevented from escaping.

In use of the device, before the manipulator 18 with the applicator vessel 15 is inserted in the replacement pipe 13 and moved to the branch pipe 12, a length of liner sleeve 23 of fibrous flexible sheet material, which may be woven or nonwoven, is impregnated with a suitable curable synthetic resin and attached to the applicator vessel 15. To attach the liner sleeve 23, the end portion of the liner sleeve is pulled over the mouth portion of the applicator vessel 15 and secured by a string 24. Instead of a string, any other suitable attachment means (not shown) may be used. Preferably, the string is tied about the applicator vessel and the liner sleeve such that it can be untied or slackened by pulling a release string 25 from the manhole. The main portion of the liner sleeve

23 is tucked into the applicator vessel 15 together with the inflatable bag 20, see Fig. 1. To facilitate the pulling of the liner sleeve 23 over the mouth portion of the applicator vessel 15 and the folding of the sleeve about the edge of the mouth 16 when the sleeve is tucked into the 5 vessel, the end portion of the sleeve may be slitted longitudinally at suitable circumferential intervals.

When the applicator vessel 15 with the impregnated liner 23 received therein is positioned opposite the branch pipe 12 as shown in Figs. 1 and 10 3, compressed air is fed through the hose 19 into the applicator vessel 15 to force the inflatable bag 20 out of the applicator vessel. The fluid pressure that is thereby applied to the liner sleeve 23 through the intermediary of the bag 20 causes the liner sleeve to evert from the applicator vessel 15 into the branch pipe 12. Continued admission of compressed air into the applicator vessel 15 causes the inflatable bag 20 15 to expand and press the liner sleeve firmly against the wall of the replacement pipe hole 14 and the inside of the branch pipe 12.

The inflatable bag 20 is maintained in the expanded state until the synthetic resin with which the liner sleeve 23 is impregnated has cured.

After the synthetic resin has cured sufficiently to maintain the 20 shape of the liner sleeve 23, the inflatable bag 20 is deflated, the string 24 is released or slackened, and the applicator vessel 15 is withdrawn. In case the inflatable bag 20 adheres too firmly to the liner sleeve 23 to become withdrawn by the movement of the applicator vessel 15 and instead is ripped away from the mouth of the applicator vessel, that 25 part of the inflatable bag which blocks the branch pipe may be removed by application of heat. Alternatively, it may be pulled away by means of the string 22 which may be attached to the applicator vessel or extended from the applicator vessel such that it can be pulled from the manhole. As a further alternative, negative pressure may be applied within the applicator vessel to retract the bag into it. For this purpose, the hose 19 can 30 be used.

If required or desired, that part of the applied liner sleeve which projects into the replacement pipe 13 may be trimmed away using a cutter tool (not shown) supported by the manipulator 18.

35 In the above-described embodiment of the invention, compressed air is used to expand the bag 20 to cause it to press the liner sleeve 23 firmly against the wall of the hole 14 of the replacement pipe 13 and the inside of the branch pipe 12. As is readily appreciated fluids other than air, preferably water, can be used for this purpose.

If it is desired to apply a liner sleeve which is longer than can be accommodated in an applicator vessel that extends across the replacement pipe as shown in the drawings, a modified applicator vessel can be used  
5 which is bent such that the part of it remote from the mouth extends longitudinally of the replacement pipe.

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Claims

1. A method of renovating a duct system, such as a sewer system, comprising a main duct (11) and a branch duct (12) connected with the main duct, the method comprising the steps of inserting a replacement pipe (13) into the main duct (11), cutting a hole (14) in the replacement pipe (13) opposite the branch duct (12), and introducing from the interior of the replacement pipe (13) a tubular lining element (23) which extends from the inside of the replacement pipe (13) and along the inside of the branch duct (12) over at least part of the full length thereof to provide a seal between the branch duct (12) and the replacement pipe (13), characterised by the steps of inserting into an applicator vessel (11) a liner sleeve (23) of fibrous flexible sheet material impregnated with curable synthetic resin and securing one end of the liner sleeve (23) to the vessel (15) around its mouth (16), positioning the mouth (16) of the vessel (15) opposite the hole (14) in the replacement pipe (13), everting the liner sleeve (23) from the vessel (15) into the branch duct (12) and pressing the liner sleeve (23) into firm contact with the wall (16) of the hole (14) in the replacement pipe (13) and with the inside of the branch duct (12), said everting and pressing of the liner sleeve (23) being effected by applying fluid pressure to the liner sleeve (23) on the side thereof which is the inner side when the liner sleeve is everted into the branch duct (12), allowing the synthetic resin to cure and thereupon relieving the fluid pressure.

2. A method according to claim 1, characterised in that said one end of the liner sleeve (23) is folded about the edge of the mouth (16) of the applicator vessel (15) and secured to the applicator vessel on the outer side thereof.

3. A method according to claim 1 or 2, characterised in that the fluid pressure is applied through the intermediary of an inflatable bag (20) and in that the inflatable bag is pressurised from within the applicator vessel (15).

4. A method according to claim 3, characterised in that subsequent to the curing of the synthetic resin, negative pressure is applied within the inflatable bag (20) to retract it into the applicator vessel (15).

5. A device for use in carrying out the method according to any one of claims 1 to 4 comprising a cup-shaped applicator vessel (15) adapted for insertion into the replacement pipe (13), an inflatable bag (20) which is sealingly attached to the applicator vessel (15) around the mouth (16) of the vessel and which is adapted to be received within the

vessel, and conduit means (19) for supplying pressurised fluid into the vessel (15) between the inside of the vessel (15) and the inflatable bag (20).

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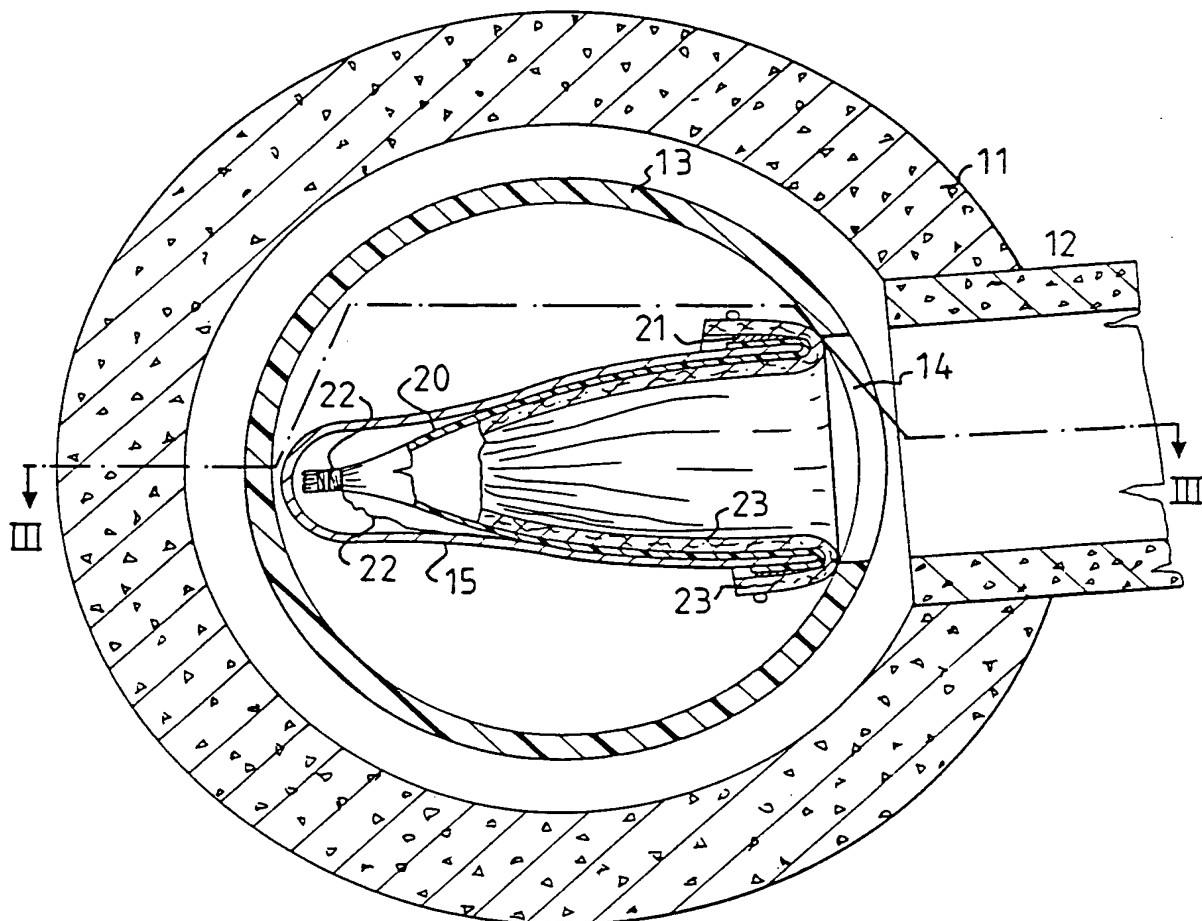


FIG.1

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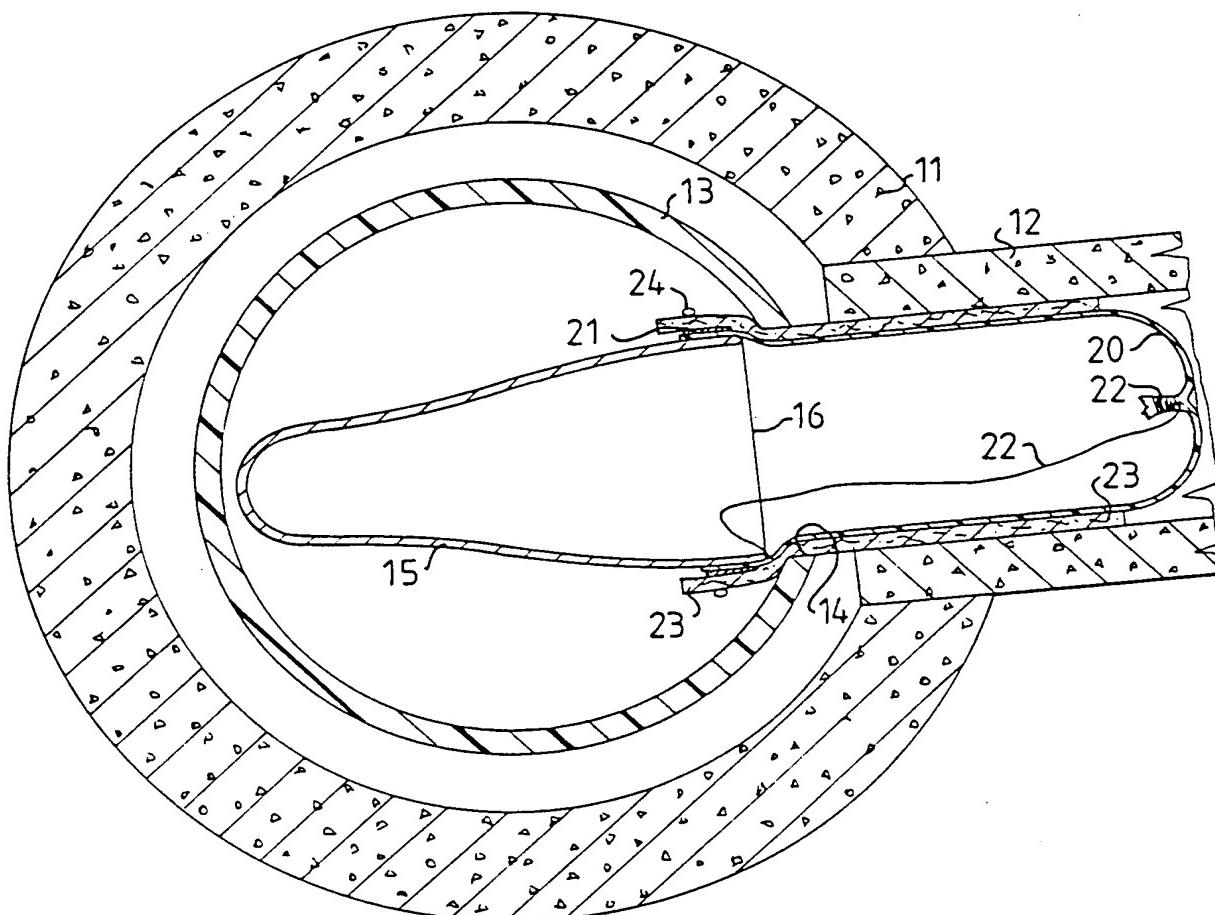


FIG. 2

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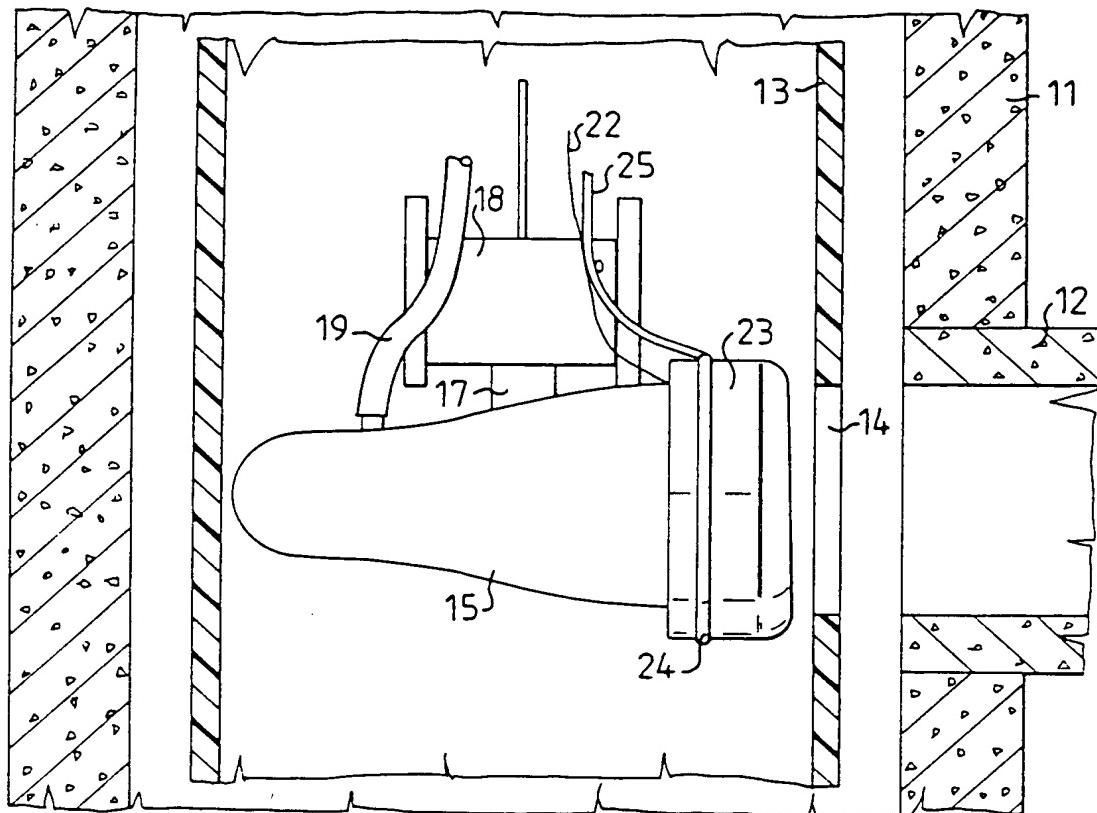


FIG. 3

# INTERNATIONAL SEARCH REPORT

International Application No PCT/SE89/00077

## I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) \*

According to International Patent Classification (IPC) or to both National Classification and IPC 4

F 16 L 55/16

## II. FIELDS SEARCHED

### Minimum Documentation Searched ?

Classification System	Classification Symbols
IPC 4	F 16 L 55/16/-18, 41/08; E 03 F 3/04/-06, 7/00/-02
US Cl	<u>138</u> : 97-98, 93; <u>156</u> : 287, 294; <u>264</u> : 36; <u>405</u> : 154-157

Documentation Searched other than Minimum Documentation  
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## III. DOCUMENTS CONSIDERED TO BE RELEVANT\*

Category *	Citation of Document, ** with indication, where appropriate, of the relevant passages ***	Relevant to Claim No. 13
A	DE, A1, 3 618 963 (VOSS, ADOLF) 10 December 1987 see column 3, lines 58-68 and column 4, lines 1-58	1-5
A	WO, A1, 82/04086 (HAXEY ENGINEERING LIMITED) 25 November 1982 see page 3, lines 24-35 and page 4, lines 1-20	1-5
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## IV. CERTIFICATION

Date of the Actual Completion of the International Search

1989-05-09

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1989 -05- 17

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Tommy Blomberg